Nanoscale X-ray Imaging Tells Tale of Two Proteins

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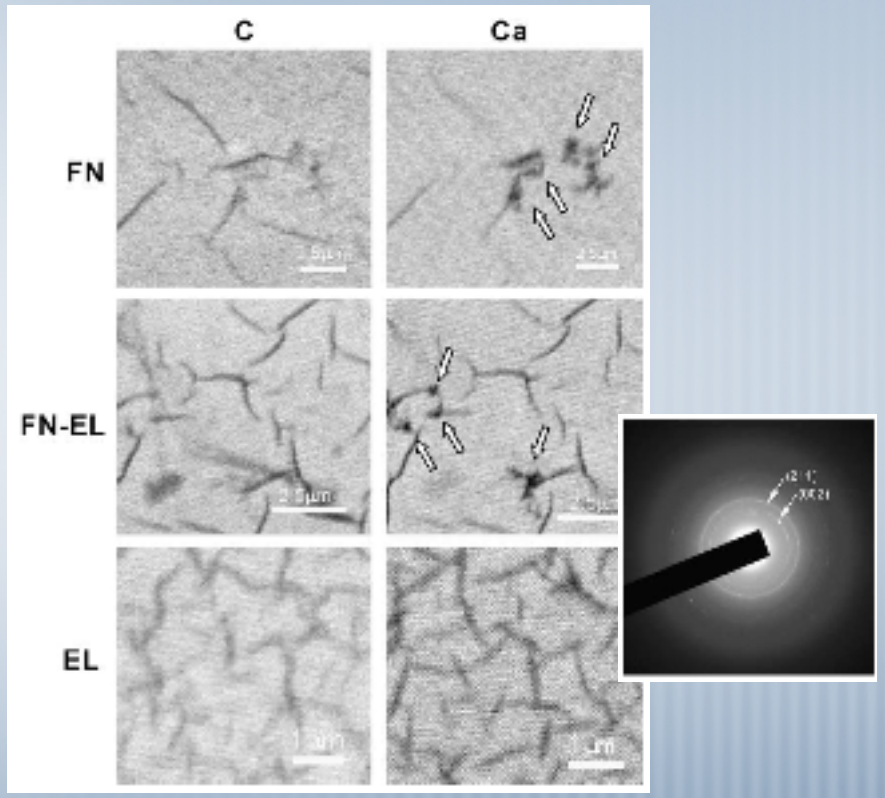
- Biomineralization, including bone growth, takes place in a matrix of proteins, whose composition and tertiary structure determine the outcome of crystal nucleation and growth. We applied soft x-ray micro-spectroscopy (STXM) to study complementary effects of the skin-tissue proteins fibronectin and elastin.
- STXM imaging creates maps with 25 nm spatial resolution and chemical specificity. The protein fibers are imaged at the C absorption edge. At the Ca edge, distinct particles are revealed – but only at fibronectin-bearing films. Synchrotron x-ray diffraction and TEM confirm that the particles crystallize into hydroxyapatite. Elastin by contrast adsorbs Ca into the protein fibers without mineralizing.
- This study found that acting together, fibronectin and elastin nucleated a denser coverage of crystals at an earlier time. Such cooperative effects on crystal growth are the essence of Biomineralization.



STXM optical density images at x-ray energies of 288.2 eV (Left column, C K-edge) and 349.3 eV (right, Ca L-edge).

Xiaolan Ba, Miriam Rafailovich, Yizhi Meng, Nadine Pernodet, Sue Wirick, Yi-Xian Qin, and Elaine DiMasi, "Complementary Effects of Multi-Protein Components on Biomineralization in vitro," J. Struct. Biol. 170, 83 (2010).

Work performed on Beamlines X1A1 and X6B.